

U.S. Patent Application Serial No. 09/180,432
Amendment dated May 17, 2004
Reply to OA of February 27, 2004

IN THE CLAIMS

Please cancel claim 10 without prejudice or disclaimer.

Please amend claims 1 and 42, and add new claims 55-57 as follows:

Claim 1 (Currently amended): A thermal acoustic insulation material comprising:
a multiplicity of anisotropic pitch-based carbon fibers having an average fiber diameter of not less than 0.5 μm but less than ~~2 μm~~ 1.3 μm and an average fiber length of 1 mm to 15 mm, said carbon fibers being non-galvanic corrosive and being bonded by a thermosetting resin at contact points of said carbon fibers so as to form a carbon fiber aggregate having a bulk density of from 3 kg/m³ to 10 kg/m³;
wherein said thermal-acoustic insulation material is non-galvanic corrosive.

Claim 2 (Previously presented): A thermal-acoustic insulation material as in claim 1, wherein said thermal-acoustic insulation material shows a galvanic current of 10 μA or lower in a galvanic cell having an electrode made of said thermal-acoustic insulation material, another electrode made of an aluminum plate, and an electrolytic solution of 0.45 wt. % aqueous sodium chloride solution.

Claim 3 (Previously presented): A thermal-acoustic insulation material as in claim 1, wherein said anisotropic pitched-based carbon fibers have an average fiber diameter of from 0.5 μm to 1.0 μm .

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Claim 4 (Previously presented): A thermal-acoustic insulation material as in claim 1, which has a maximum tensile strength of 1.0 g/mm² or higher.

Claim 5 (Previously presented): A thermal-acoustic insulation material as in claim 1, which has a compression recovery rate of 70% or higher.

Claim 6 (Previously presented): A thermal-acoustic insulation material as in claim 1, wherein a minimum tensile strength of the orthogonal direction to said maximum tensile strength is 0.04 times or higher as said maximum tensile strength and, at the same time, a tensile strength of the orthogonal direction to both the direction of said maximum tensile strength and the direction of said minimum tensile strength is 0.76 times or higher as said maximum tensile strength.

Claim 7 (Previously presented): A thermal-acoustic insulation material as in claim 1, which has a thermal conductivity of 0.039 W/m•°C. or lower.

Claim 8 (Previously presented): A thermal-acoustic insulation material as in claim 1, wherein a vertical incident acoustic absorptivity at a frequency of 1000 Hz of said thermal-acoustic insulation material with a thickness of 25 mm is 48% or higher.

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Claim 9 (Previously presented): A thermal-acoustic insulation material as in claim 1, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

Claim 10 (Canceled).

Claim 11 (Previously presented): A method of manufacturing thermal-acoustic insulation material, comprising the steps of:

producing spun fibers having an average fiber diameter less than 2 μm and an average fiber length of 1 mm to 15 mm by heating and melting anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon, then discharging a melted matter out of a spinning nozzle and at the same time, blowing a heated gas from around the spinning nozzle in the same direction in which the melted matter is discharged;

manufacturing non-galvanic corrosive carbon fibers by infusibilizing said spun fibers and thereafter carbonizing said spun fibers at not lower than 550°C. but lower than 800°C.;

forming a carbon fiber aggregate having a bulk density less than 1.3 kg/m³ by aggregating said non-galvanic corrosive carbon fibers;

spraying a thermosetting resin solution to the carbon fiber aggregate; and

curing the thermosetting resin by compressing and heating the carbon fiber aggregate sprayed with the thermosetting resin solution to bond contact points of said carbon fibers and thereby

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manufacture a three dimensional structure of carbon fibers having a bulk density of from 3 kg/m³ to 10 kg/m³.

Claim 12 (Previously presented): A method of manufacturing a thermal-acoustic insulation material as in claim 11, wherein in said step of forming a carbon fiber aggregate, said non-galvanic corrosive carbon fibers are opened by the air and dropped from a height of at least 100 cm or higher onto a plane.

Claims 13-14 (Canceled).

Claim 15 (Previously presented): A thermal-acoustic insulation material as in claim 2, which has a maximum tensile strength of 1.0 g/mm² or higher.

Claim 16 (Previously presented): A thermal-acoustic insulation material as in claim 3, which has a maximum tensile strength of 1.0 g/mm² or higher.

Claim 17 (Previously presented): A thermal-acoustic insulation material as in claim 2, which has a compression recovery rate of 70% or higher.

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Claim 18 (Previously presented): A thermal-acoustic insulation material as in claim 3, which has a compression recovery rate of 70% or higher.

Claim 19 (Previously presented): A thermal-acoustic insulation material as in claim 4, which has a compression recovery rate of 70% of higher.

Claim 20 (Previously presented): A thermal-acoustic insulation material as in claim 2, wherein a minimum tensile strength of the orthogonal direction to said maximum tensile strength is 0.04 times or higher as said maximum tensile strength and, at the same time, a tensile strength of the orthogonal direction to both the direction of said maximum tensile strength and the direction of said minimum tensile strength is 0.76 times or higher as said maximum tensile strength.

Claim 21 (Previously presented): A thermal-acoustic insulation material as in claim 3, wherein a minimum tensile strength of the orthogonal direction to said maximum tensile strength is 0.04 times or higher as said maximum tensile strength and, at the same time, a tensile strength of the orthogonal direction to both the direction of said maximum tensile strength and the direction of said minimum tensile strength is 0.76 times or higher as said maximum tensile strength.

Claim 22 (Previously presented): A thermal-acoustic insulation material as in claim 4,

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wherein a minimum tensile strength of the orthogonal direction to said maximum tensile strength is 0.04 times or higher as said maximum tensile strength and, at the same time, a tensile strength of the orthogonal direction to both the direction of said maximum tensile strength and the direction of minimum tensile strength is 0.76 times or higher as said maximum tensile strength.

Claim 23 (Previously presented): A thermal-acoustic insulation material as in claim 5, wherein a minimum tensile strength of the orthogonal direction to said maximum tensile strength is 0.04 times or higher as said maximum tensile strength and, at the same time, a tensile strength of the orthogonal direction to both the direction of said maximum tensile strength and the direction of minimum tensile strength is 0.76 times or higher as said maximum tensile strength.

Claim 24 (Previously presented): A thermal-acoustic insulation material as in claim 2, which has a thermal conductivity of 0.039 W/m•°C. or lower.

Claim 25 (Previously presented): A thermal-acoustic insulation material as in claim 3, which has a thermal conductivity of 0.039 W/m•°C. or lower.

Claim 26 (Previously presented): A thermal-acoustic insulation material as in claim 4, which has a thermal conductivity of 0.039 W/m•°C. or lower.

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Claim 27 (Previously presented): A thermal-acoustic insulation material as in claim 5, which has a thermal conductivity of 0.039 W/m•°C. or lower.

Claim 28 (Previously presented): A thermal-acoustic insulation material as in claim 6, which has a thermal conductivity of 0.039 W/m•°C. or lower.

Claim 29 (Previously presented): A thermal-acoustic insulation material as in claim 2, wherein a vertical incident acoustic absorptivity at a frequency of 1000Hz of said thermal-acoustic insulation material with a thickness of 25 mm is 48% or higher.

Claim 30 (Previously presented): A thermal-acoustic insulation material as in claim 3, wherein a vertical incident acoustic absorptivity at a frequency of 1000Hz of said thermal-acoustic insulation material with a thickness of 25 mm is 48% or higher.

Claim 31 (Previously presented): A thermal-acoustic insulation material as in claim 4, wherein a vertical incident acoustic absorptivity at a frequency of 1000Hz of said thermal-acoustic insulation material with a thickness of 25 mm is 48% or higher.

Claim 32 (Previously presented): A thermal-acoustic insulation material as in claim 5,

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wherein a vertical incident acoustic absorptivity at a frequency of 1000Hz of said thermal-acoustic insulation material with a thickness of 25 mm is 48% or higher.

Claim 33 (Previously presented): A thermal-acoustic insulation material as in claim 6, wherein a vertical incident acoustic absorptivity at a frequency of 1000Hz of said thermal-acoustic insulation material with a thickness of 25 mm is 48% or higher.

Claim 34 (Previously presented): A thermal-acoustic insulation material as in claim 7, wherein a vertical incident acoustic absorptivity at a frequency of 1000Hz of said thermal-acoustic insulation material with a thickness of 25 mm is 48% or higher.

Claim 35 (Previously presented): A thermal-acoustic insulation material as in claim 2, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

Claim 36 (Previously presented): A thermal-acoustic insulation material as in claim 3, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

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Claim 37 (Previously presented): A thermal-acoustic insulation material as in claim 4, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

Claim 38 (Previously presented): A thermal-acoustic insulation material as in claim 5, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

Claim 39 (Previously presented): A thermal-acoustic insulation material as in claim 6, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

Claim 40 (Previously presented): A thermal-acoustic insulation material as in claim 7, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

Claim 41 (Previously presented): A thermal-acoustic insulation material as in claim 8, wherein said carbon fibers are produced from anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon.

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Claim 42 (Currently amended): ~~A~~ The method of manufacturing a thermal-acoustic insulation material as in ~~any one of claims 55 or 57~~ claim 10, ~~a temperature of said~~ carbonizing ~~is carried out at a temperature of the spun fibers~~ is not lower than 650°C. but lower than 750°C.

Claim 43 (Previously presented): A method of manufacturing a thermal-acoustic insulation material as in claim 11, wherein a temperature of carbonizing the spun fibers is not lower than 650°C. but lower than 750°C.

Claims 44-54 (Canceled).

Claim 55 (New): A method of manufacturing a thermal-acoustic insulation material, comprising the steps of:

producing spun fibers having an average fiber diameter of from 0.5 μm to 5.0 μm and an average fiber length of 1 mm to 15 mm, said producing comprising heating and melting anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon to produce melted pitch, and discharging said melted pitch out of a spinning nozzle while at the same time, blowing a heated gas from around the spinning nozzle in the same direction that the melted pitch is discharged, to form said spun fibers;

manufacturing non-galvanic corrosive carbon fibers comprising infusibilizing said spun fibers to form infusibilized fibers, and thereafter carbonizing said infusibilized fibers at a

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temperature of not lower than 550°C but lower than 800°C, to form said non-galvanic corrosive carbon fibers;

forming a carbon fiber aggregate comprising aggregating and compressing said non-galvanic corrosive carbon fibers to a bulk density of from (3-b) kg/m³ to (10 - b) kg/m³, to form said carbon fiber aggregate;

spraying a thermosetting resin solution to said carbon fiber aggregate so that the amount of a thermosetting resin in relation to the amount of the carbon fiber aggregate is b, where b is an arbitrary number fixed so that the bulk density is positive and the relationship 0.3 ≤ b ≤ 4 is satisfied, to form a sprayed aggregate; and

curing said thermosetting resin comprising heating said sprayed aggregate, to form a three-dimensional structure of carbon fibers wherein said carbon fibers are bonded at contact points thereof, said three-dimensional structure having a bulk density of from 3 kg/m³ to 10 kg/m³.

Claim 56 (New): A method of manufacturing a thermal-acoustic insulation material, comprising the steps of:

producing spun fibers having an average fiber diameter less than 2 μm and an average fiber length of 1 mm to 15 mm, said producing comprising heating and melting anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon to produce melted pitch, and discharging said melted pitch out of a spinning nozzle while at the same time, blowing a heated gas from around the spinning nozzle in the same direction that the melted pitch is discharged, to form said spun fibers;

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manufacturing non-galvanic corrosive carbon fibers comprising infusibilizing said spun fibers to form infusibilized fibers, and thereafter carbonizing said infusibilized fibers at a temperature of not lower than 650°C but lower than 750°C, to form said non-galvanic corrosive carbon fibers;

forming a carbon fiber aggregate comprising aggregating and compressing said non-galvanic corrosive carbon fibers to a bulk density of from (3-b) kg/m³ to (10 - b) kg/m³, to form said carbon fiber aggregate;

spraying a thermosetting resin solution to said carbon fiber aggregate so that the amount of a thermosetting resin in relation to the amount of the carbon fiber aggregate is b, where b is an arbitrary number fixed so that the bulk density is positive and the relationship 0.3 ≤ b ≤ 4 is satisfied, to form a sprayed aggregate; and

curing said thermosetting resin comprising heating said sprayed aggregate, to form a three-dimensional structure of carbon fibers wherein said carbon fibers are bonded at contact points thereof, said three-dimensional structure having a bulk density of from 3 kg/m³ to 10 kg/m³.

Claim 57 (New): A method of manufacturing a thermal-acoustic insulation material, comprising the steps of:

producing spun fibers having an average fiber diameter of not less than 0.5 μm but less than 1.3 μm and an average fiber length of 1 mm to 15 mm, said producing comprising heating and melting anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon to produce

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molten pitch, and discharging said molten pitch out of a spinning nozzle while at the same time, blowing a heated gas from around the spinning nozzle in the same direction that the molten pitch is discharged, to form said spun fibers;

manufacturing non-galvanic corrosive carbon fibers comprising infusibilizing said spun fibers to form infusibilized fibers and carbonizing said infusibilized fibers at not lower than 550°C but lower than 800°C, to form said non-galvanic corrosive carbon fibers;

forming a carbon fiber aggregate comprising aggregating and compressing said non-galvanic corrosive carbon fibers to a bulk density of from (3-b) kg/m³ to (10 - b) kg/m³, to form said carbon fiber aggregate;

spraying a thermosetting resin solution to said carbon fiber aggregate so that the amount of a thermosetting resin in relation to the amount of the carbon fiber aggregate is b, where b is an arbitrary number fixed so that the bulk density is positive and the relationship $0.3 \leq b \leq 4$ is satisfied, to form a sprayed aggregate; and

curing said thermosetting resin comprising heating said sprayed aggregate, to form a three-dimensional structure of carbon fibers, wherein said carbon fibers are bonded at contact points thereof, and said three-dimensional structure has a bulk density of from 3 kg/m³ to 10 kg/m³.